

CHAPS Planning Session: Overview

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DEPARTMENT OF ENERGY
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Overview

- Primary Goal: to characterize and contrast freshly emitted aerosols above, within and below fair weather cu's
- The 'big' question: how do below-cloud and above-cloud aerosol optical and cloud nucleating properties differ downwind of a mid-size city relative to similar aerosols in air less affected by emissions?
- Key Platforms
 - DOE Gulfstream aircraft
 - NASA King Air Be-2000
- Strategy: look at aerosols properties in aggregate



Science Issues

- Transformation and transport of aerosols between the free atmosphere (FA) and planetary boundary layer (PBL).
 - Aerosol lifetime in FA > than in PBL
 - hence can have effects over larger areas.
- Aqueous phase reactions can lead to differences in optical properties of aerosols below and above clouds.
- Selective removal of aerosols as function of composition
- How well do models simulate changes in composition and size distribution as aerosols move from moist PBL to drier FA?



Programmatic Issue

- To what extent can large-scale models with state of the art cloud parameterizations capture the statistical features of the below-above cloud aerosol fields?
 - The vertical distribution of aerosols remains one of the largest source of disagreement among models,
- Even models which do include a parameterization for FWC, like the NCAR Community Atmosphere Model (CAM3), ignore the sub-grid variability of temperature and moisture in the model grid cell with the result that little can be said about the evolution of aerosol properties within these simulated domains.



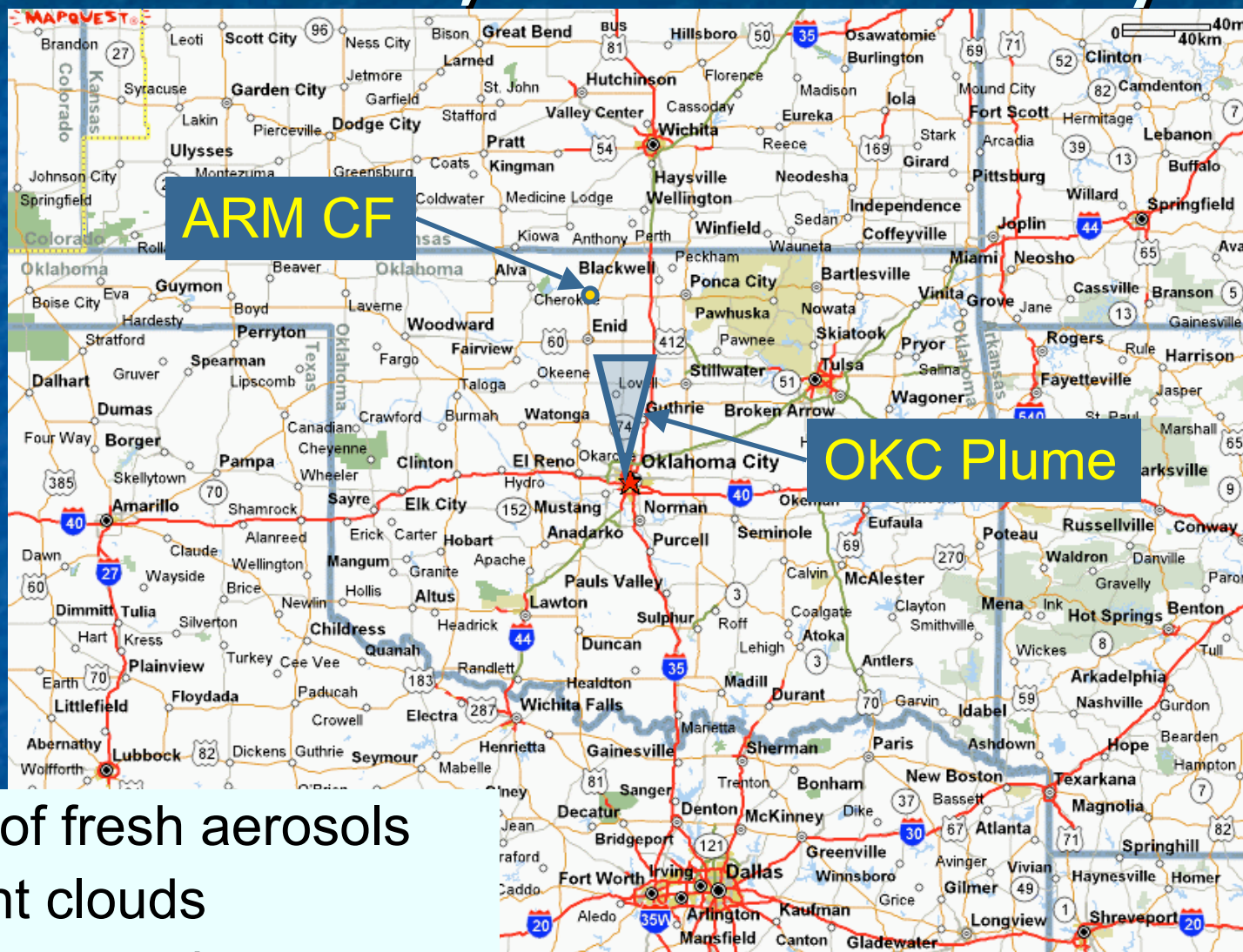
Operational Science Questions

- How do below-cloud and above-cloud aerosol optical and cloud nucleating properties differ downwind of a typical North American city from those properties in air unperturbed by the urban emissions?
- How does the distribution of aerosol extinction vary in relation to proximity to individual clouds and fields of clouds and why?
- What are the differences between activated aerosols within the urban plume, and those outside the urban plume? What are the differences between aerosols that have not been activated within and outside the urban plume?





June 2007, Oklahoma City

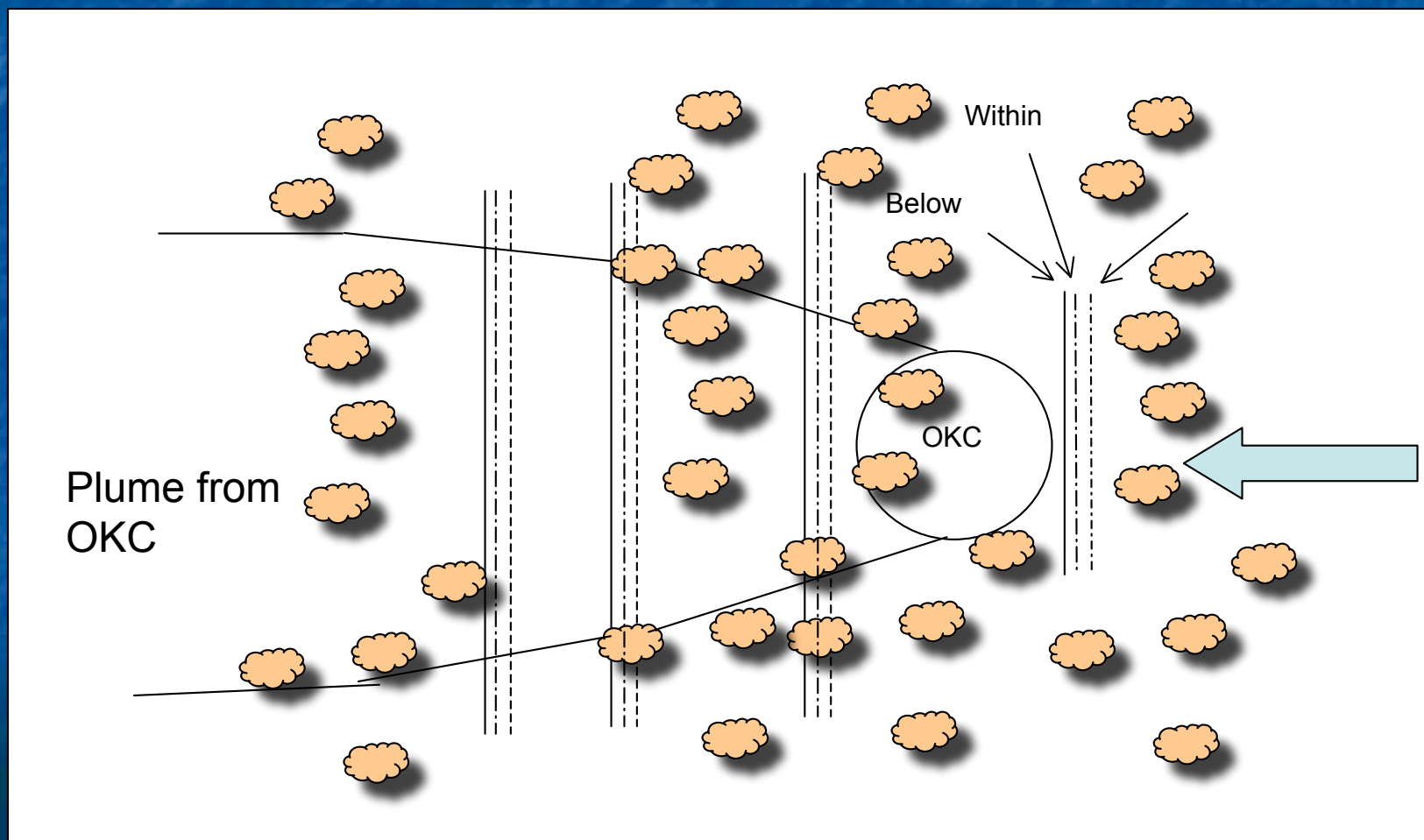


- Source of fresh aerosols
- Frequent clouds
- CLASIC campaign

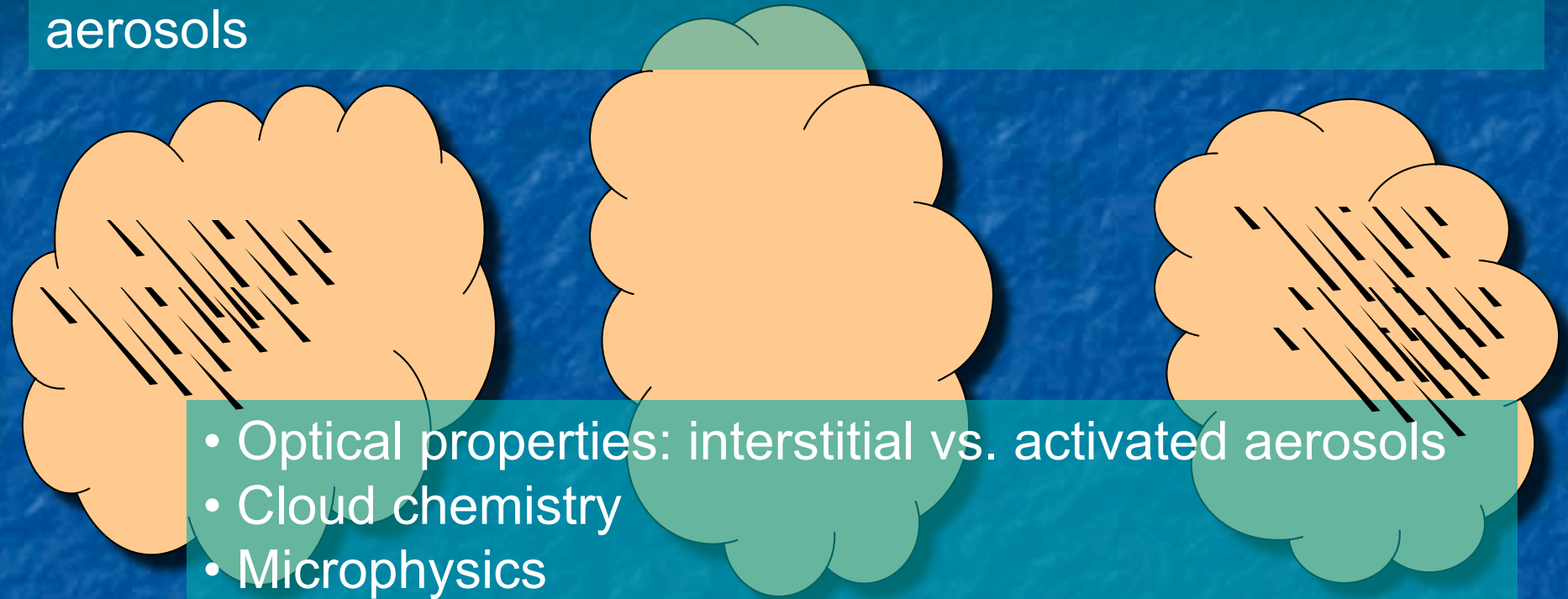


G-1: upwind (low & high),
downwind (low & high)

Be-200/HSRL: sampling over G-1 at ~25-28kft.



- Size, composition, optical properties of free atmosphere aerosols



- Optical properties: interstitial vs. activated aerosols
- Cloud chemistry
- Microphysics

- Size, composition, optical properties of boundary layer aerosols



Collection of Aggregate Data (not individual clouds)



4) Minimal sampling above cloud top

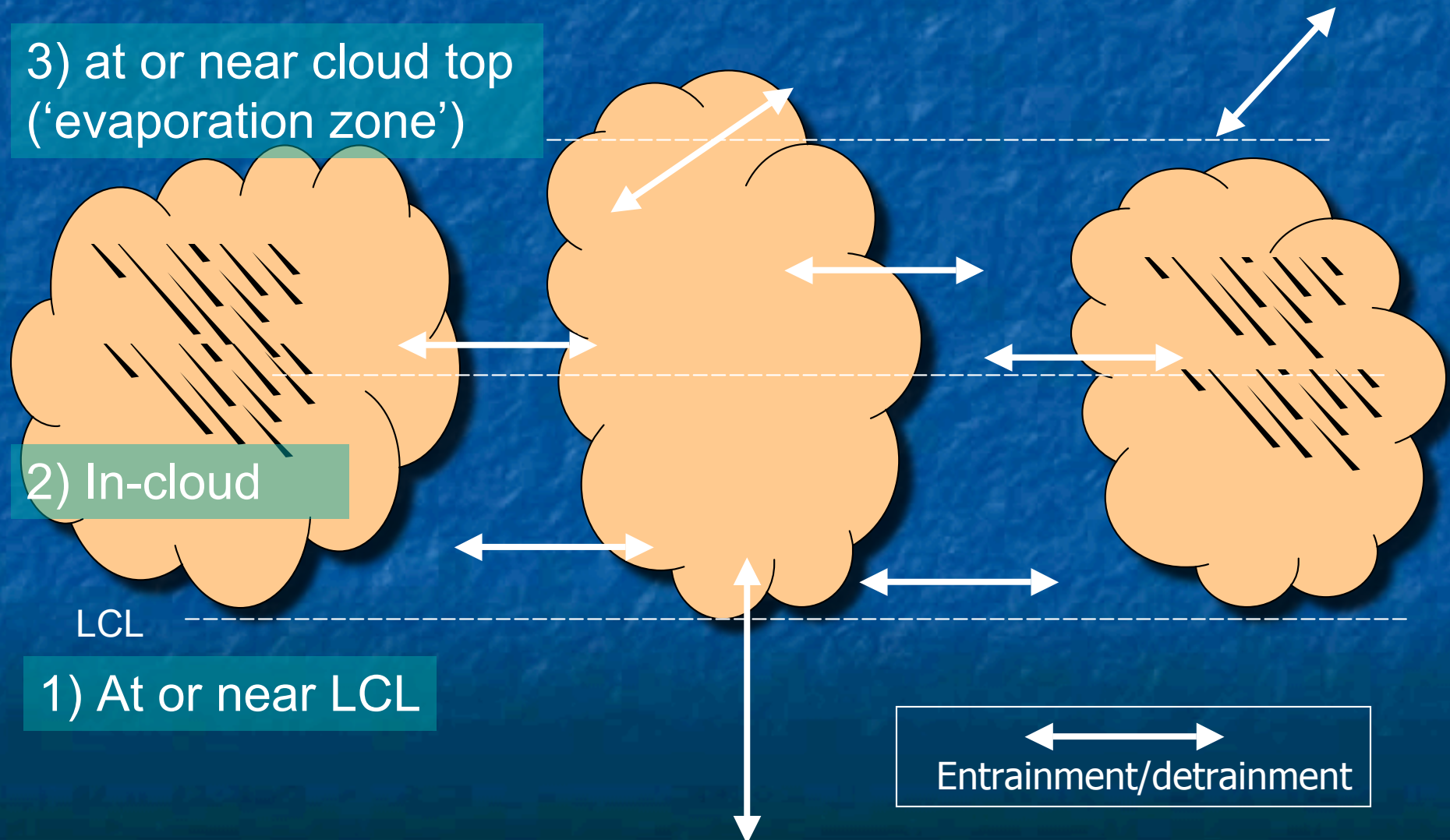
3) at or near cloud top
(‘evaporation zone’)

2) In-cloud

LCL

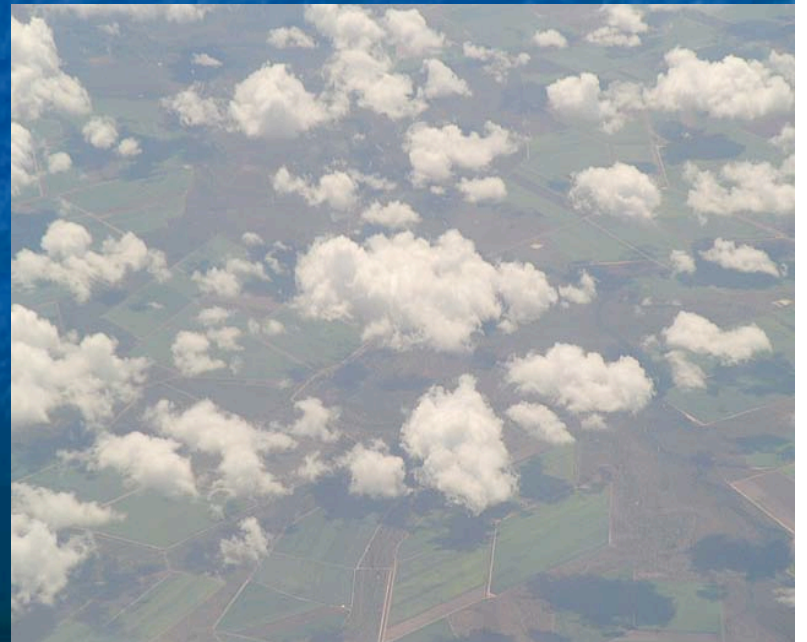
1) At or near LCL

Entrainment/detrainment



Focus on Cumulus Humilis

- Why fair-weather Cu?
 - Little precipitation
 - Simple dynamics
 - Significant transport through cloud ($\sim 30\%$ /hour)



ARM Cloud and Land Surface Interaction Campaign (CLASIC)

- Science drivers involve land surface processes and their role on cumulus microphysics.
- Overlap between CLASIC and CHAPS:
 - cloud microphysics
 - Aerosol radiative properties
 - Location and timing of campaigns



Planning Issues

- Continued interaction with FAA
 - preliminary approval obtained
- Coordination with CLASIC field plans
- Infrastructure Support
 - Profilers, sonde launches (how many?)
 - Surface aerosol observations
 - Total Sky Imagers
 - How many and where?
 - MultiFilter Rotating Shadowband Radiometer(s)



Schedule of Events

- January – delivery of CVI head from NOAA to PNNL for installation on G-1.
- February – 1) install and test CVI/aerosol instruments 2) planning meeting with CLASIC Aircraft team (Dallas, Texas?)
- April – 1) begin install of non-CVI instruments (AMS, SO₂, H₂O₂, CO...) 2) testing of combined CVI and non-CVI instruments
- May (end) – sonde launch sites set up, profiler deployed.
- June 1st – G-1 to Oklahoma
- June 30th – end of CHAPS

